

NINE. Hm. psit; Le. pefcuꝛc (= pesac, *one* [*sum?*], éin), wanting, wan̄ka, *one*); Bl. piksua.

TEN. Hm., Cp. mnt, met, meti; Sha. metatvi; Po. matatso; Cree mitatat, mitatano; Shy, matokto; At. matatasits. Compare Cp. meti, *half*; L. medius, *dimidium*; S. madhya; Y. medji, *two*. Roots denoting measurement (*metior, mete, &c.*), may very naturally have been derived from the same root as met, *ten*.

From comparisons like the foregoing, it appears that the primitive numerals, so far as I have been able to trace their probable origin, were intended to convey the following ideas:

ONE. Existence, a piece, a group.

TWO. Division, repetition.

THREE. Collection.

FOUR. Twice two.

FIVE. Hand, division, collection.

SIX. Second one, five-one, twice three.

SEVEN. Second two, five-two.

EIGHT. Second three, five-three, twice four, two from ten.

NINE. One from ten, three threes.

TEN. One (group), two (fives).

Pending nominations Nos. 534, 535, 536, and 537, were read.

A discussion took place respecting the remaining volumes of Duponceau's Memoir on the Chinese Language.

And the Society was then adjourned.

Stated Meeting, March 3, 1865.

Present, ten members.

Dr. WOOD, President, in the Chair.

A letter inclosing a photograph was received from Mr. C. A. Schott, dated Washington, March 1, 1865.

Donations for the Library were received from the Royal Astronomical Society, Prof. James Hall, the Franklin Institute, the Academy of Natural Sciences in Philadelphia, the National Academy, and Mr. C. H. Hart.

The Secretary laid on the tables copies of the Proceedings No. 72, just published, with revised lists of the members, &c.

Mr. Marsh communicated the results of calculations in reference to the heights of the auroras of January 16, and February 20 and 21, which led to a prolonged discussion of magnetic phenomena by the members present.

About 7 o'clock on the evening of January 16, at Germantown (lat. $40^{\circ} 1'$ long. $75^{\circ} 11'$), my attention was called to a bright mass of white auroral light, stretching E. and W. from horizon to horizon, in the form of a pretty regular and well-defined arch, $2\frac{1}{2}^{\circ}$ to 3° in width, having its highest point marked very nearly by Zeta Ursæ Majoris. Below it only a dark segment was observed. Of its position and appearance from time to time, I made the following notes :

H. M.

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|-------|-------|--|
| 7 0 | P. M. | Upper edge reached Zeta Urs. Maj., or very nearly so; outline regular. |
| 7 10 | " | Upper edge reached Zeta Urs. Maj., or very nearly so; outline irregular. |
| 7 15 | " | Upper edge reached 1° below Zeta; outline not well defined. |
| 7 30 | " | Upper edge reached 1° @ $1\frac{1}{2}^{\circ}$ below Zeta; bright. |
| 7 38 | " | Upper edge reached 2° below Zeta; bright. |
| 7 58 | " | Upper edge reached $1\frac{1}{2}^{\circ}$ below Zeta; bright. |
| 8 8 | " | Centre of arch 1° above centre of line joining Zeta and Eta; bright. |
| 8 15 | " | Centre of arch 1° above centre of line joining Zeta and Eta; upper edge 2° below Zeta; bright. |
| 8 23 | " | About the same; very bright; the whole width of light between Zeta and Eta. |
| 8 35 | " | Aurora more extended; very bright in N. W., but clouds interfered with its exact location. |
| 9 30 | " | Quite cloudy; light more diffuse; higher. |
| 9 45 | " | Arch bright; rather higher; apparently a mere opening in the clouds. |
| 10 15 | " | Entirely obscured by clouds. |

The width of the arch, at least in the part to which the above notes particularly refer, remained nearly constant. No streamers seen, and only white light.

The "Telegraph," published at Brunswick, Maine (lat. $43^{\circ} 53'$

long. $69^{\circ} 55'$), contained the following notice by the editor (Mr. A. G. Tenney):

“We observed a magnificent aurora on Monday night, just about 8 o'clock. At that hour it formed two bows, the larger and exterior one spanning the sky from N. E. to N. W., at an angle of about 45° at its greatest elevation above the horizon, while the interior bow extended only a few degrees, and rose not more than 4° or 5° above the horizon. Both were as perfectly marked, well defined, and distinct as any rainbow that we ever saw; although, in the case of the aurora, the bows were broad bands of light, the larger one covering several degrees of the heavens.”

Mr. T. informs me that the estimated altitude was obtained by fixing his eye upon what he supposed to be the zenith, and then running it down to the upper edge of the bow, and estimating the proportional parts. On going again to the same spot, and recalling as nearly as possible the position of the arch, he was confirmed in his original estimate. But subsequently being furnished with a star chart, upon which he could trace its position, he satisfied himself that his figures were too high, and the path which he finally marked upon the chart as the result of repeated trials, indicates an elevation of only 32° . In view of the well-known tendency, in all unpractised observers, to underestimate zenith distances, this change is about what might have been anticipated, and the corrected result seems to be entitled to confidence as an approximation.

Eight o'clock at Brunswick corresponds to 7h. 39m. at German-town, at which time my notes show that the upper margin was about $1\frac{3}{4}^{\circ}$ below Zeta, or about $7\frac{1}{2}^{\circ}$ above the horizon.

Taking as a base line the difference of latitude ($3^{\circ} 52'$), and combining these results, we get for the actual height of the arch from the surface of the earth, 67.3 miles.

On the 20th of February there was another arch, which was thus noticed by Dr. Henry C. Perkins, in the “Newburyport Herald” of the following day:

“As the Pleasant Street clock struck eight last evening, a brilliant arch, about 6° or 7° in width, spanned the heavens from east to west; involving in its luminosity the four stars in the head and neck of Leo; passing about 2° to the north of Castor; having Capella on its southern edge, inclosing Perseus and Andromeda in its folds, and thence coming more directly to the west. It was quite uniform in its width and brilliancy, but lasted only a few minutes.”

This description shows that this arch passed through the zenith at

Newburyport, its southern edge having an elevation of about 89° above the southern horizon.

Fortunately, Mr. Tenney was, at the moment of its formation, engaged in correcting the altitude of that of January 16. He says:

“Whilst we were looking this evening, at 8 o'clock, there was a magnificent auroral display, mostly, however, made up of shooting beams. But all at once an arch was formed—say about 3° wide (and as it passed through the belt of Orion I have a good measure for that), the upper edge cutting just below Venus, and so on through Orion, that being its greatest elevation, and losing itself near the horizon a little south of east. The arch lasted but a few moments, but for an instant or two it shone magnificently.”

By tracing on a globe an arch 3° wide, passing through the belt of Orion, and similar in form to that indicated by Dr. Perkins's observations, we get a probable elevation of 41° for the southern margin, which, combined with the Newburyport elevation, gives 67 miles for the height of the arch.

This arch was also seen at Dr. C. Smallwood's observatory, at Montreal. He says:

“At 7h. 50m. P. M.” (exactly 8 o'clock, Newburyport time), “an auroral arch was seen from this place, stretching from horizon to horizon E. and W., passing through the constellation Orion. It was from 2° to 3° in breadth, and lasted about 18 minutes.”

Assuming this arch to have had the exact form and position of a parallel of latitude, at the height of 67 miles over Newburyport, it must, as seen from Montreal, have had a much less elevation than any of the bright stars in Orion, and could not, therefore, be said to “pass through” that constellation.

This discrepancy may, probably, have resulted from irregularity of form in this arch, combined with peculiarity of position. A glance at a globe, in connection with Dr. Perkins's report, shows that in this instance, as in several others recently, the pole of the arch was considerably to the east of north. Consequently, Brunswick, which is N. E. from Newburyport, is much more favorably situated for comparison with that place than Montreal, which is N. W. The part of the arch nearest Brunswick, is that which is nearly vertical over Newburyport, and observers, therefore, look at the very same object; whereas that nearest Montreal lies much further N. W., and may be quite different in form.

Results based upon the former appear, therefore, entitled to considerable weight, notwithstanding their disagreement with the latter.

It is evident, however, that the same peculiarity of position would require that the length of the base line, and, consequently, the height, should be somewhat increased for Newburyport and Brunswick, and diminished for Newburyport and Montreal.

Another arch, seen on the evening of February 21, is thus noticed by Robert Treat Paine, of Boston, in the "Daily Evening Traveller," of the 22d :

"At half-past 8 o'clock, bright branches of white auroral light appeared in the N. W., and also in the N. E., which at 8h. 45m., ran together, and formed a luminous arch from N. W. to N. E., the centre of which passed a few degrees above the pole star. The arch, however, was of short duration, as it continued only three or four minutes, and at ten minutes before 9 o'clock, the aurora had entirely disappeared."

H. D. Vail, at Philadelphia, carefully noted at 8h. 15m. (8h. 31m. Boston time), the position of the upper margin, its highest point being halfway between Gamma Ursæ Minoris and the horizon, or at an elevation of about $13\frac{1}{2}^{\circ}$. He did not continue his observations, but at $8\frac{1}{2}$ o'clock ($8\frac{3}{4}$, Boston time), William Dennis, at Germantown, estimated its altitude at 15° .

As Mr. Vail reports the arch seen by him to have been regular and complete, it is evident that the break existing north of Boston at $8\frac{1}{2}$ o'clock, was too far east to be visible at Philadelphia, and what Mr. V. saw must have been far to the N. W. of Boston.

Mr. Paine informs me that his attention having been mainly directed to the N. E., he is unable to speak confidently as to the exact location of the auroral branch in the N. W.; he has, however, marked on a star chart his impressions as to the positions at $8\frac{1}{2}$ and $8\frac{3}{4}$ o'clock respectively, showing a probable altitude for the highest point, of 42° for the former, and 50° for the latter.

The above altitudes, $13\frac{1}{2}^{\circ}$ and 42° combined, give the height at 8h. 30m. Boston time, 64.8 miles; at 15° and 50° combined, at 8h. 45m. Boston time, 66.2 miles.

While the extreme closeness of agreements in these results for January 16, and February 20 and 21, is, of course, accidental, the average height ($66\frac{2}{3}$ miles), seems fairly entitled to weight as a rough approximation, and in the present state of our knowledge, even such are valuable.

The results in this case agree with most others on record in indicating that it is only in auroral displays of the very first class that, in our latitude, at least, the "arch," or "curtain," is at a less height

than 50 miles. In the grand display of August 28, 1859, the height was 43 to 46 miles;* and in that of September 2, 1859, it was 50 miles. On ordinary occasions, the arch does not seem capable of penetrating the atmosphere to so great a depth.

Dr. C. Smallwood, of the Montreal Observatory, sends the following notes of observations made during a drive which was commenced before 7 o'clock on the evening of January 16; but as the exact time was not noted, they are not available for comparison in the above.

"Time, from before till after 7 P. M. Dark auroral bank in the north, surmounted by a bright auroral arch of a greenish or yellow hue, about 25° to 30° in altitude. This lasted for some hours. An auroral bow or arch stretching from horizon to horizon, due E. and W., passing the zenith, of 2° to 3° in breadth, of the same color as the other auroral appearance. Its southern border was bounded by Beta Orionis, its northern border by Procyon. It lasted a considerable time, say twenty minutes, and exhibited a very distinct and well-defined arch. It gradually vanished, but the auroral bank and appearance remained part of the night."

Mr. Tenny, also, noted another bright arch at 10 P. M. February 20, at an elevation of 12° and 15° from N. horizon; also, a fine one on the 22d, and an imperfect one on the 25th.

Of another on the 21st February, Dr. Perkins writes as follows:

"On the same evening (Tuesday), a most beautiful arch formed in the north, and became elevated, say about 8° or 10° . It was of a bright crimson hue at the base, green above this, and yellowish white above the green, looking somewhat like a low rainbow, only differently colored, its width about 5° . Soon after it was completely formed, streamers began to shoot upwards from its eastern extremity, which gradually, but rapidly, extended themselves towards the west, using up the arch entirely as it progressed, just as a slip of paper would be used up in setting it on fire at one end and burning it up."

Of the frequent auroral displays of the latter part of February, this is the only one in which streamers played a conspicuous part, the whole series being remarkably characterized by the *exclusive* prevalence of auroral "arches."

Pending nominations, Nos. 534, 535, 536, and 537, were read.

And the Society was adjourned.

* Journal of Franklin Institute, 3d series, vol. 38, p. 353. Am. Journ. Science, 2d series, vol. 32, pp. 320, 322.